

## Review 2

1 hour exam, in Clark 101, 2-3pm, Oct. 8, Wednesday

ID will be checked when the exam is turned in.

A single page cheat sheet is allowed, but it can only contain equations and constants.

Five multiple choice questions, 5 points each, only one answer.

Four simple questions, 6-10 points each

Two complex questions, ~20 points each

### 1. Particle in a box

Hamiltonian, general solution of Schrodinger equation, boundary conditions and quantization of energy, ZPE, wavefunction and normalization, nodes, energy gaps and transition frequency, expectation values for position and momentum operators, 2D and 3D cases, degeneracy, real world applications, tunneling, STM.

### 2. Uncertainty principle

Commutator, complementary variables, Heisenberg's uncertainty principle.

### 3. Harmonic oscillator and rigid rotor

Hamiltonian, Hermite polynomials, quantization of energy, vibrational frequency, ZPE, energy gaps and transition frequency, wavefunction and nodes, orthonormality, tunneling, expectation values, reduced mass for molecular oscillators.

Hamiltonian in polar and spherical coordinates, cyclic boundary conditions and energy quantization, wavefunctions, spherical harmonics as eigenfunctions of  $L_z$  and  $L^2$ , two quantum numbers, quantization in both magnitude and orientations, vector model.